SUMMARY OF ATRAZINE IN EPA REGION 6 SURFACE WATERS

August 2002

U.S. Environmental Protection Agency, Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733

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PREFACE

In February of 1999 a cross program EPA Region 6 work group was formed to address an issue that was highlighted by EPA management: atrazine in surface waters. Work group members included Mike Bechdol, Jerry Collins, Philip Crocker, Brad Lamb, Van Kozak, Omar Martinez, Sharon Parrish, Sylvia Ritzky, Randall Rush, Ken Williams and Carl Young. In response to the need to better understand atrazine's effects on surface water in Region 6and to better coordinate between the water and pesticide programs, a Memorandum of Understanding was established between the Water Quality Protection and Multi-media Planning and Permitting Divisions. The MOA, which was signed in July 1999, established a framework for programmatic coordination. The work group met on a quarterly basis for a three year period and also interfaced with the Texas Watershed Protection Committee, a committee represented by state and Federal agencies in Texas with the focus being on atrazine. The Region 6 work group decided that a summary report of atrazine in Region 6 surface waters would be useful in the coordination process. This report was prepared by a subgroup to document available information on the nature of the atrazine problem, including areas of concern, data gaps, and activities underway by EPA and the states which are related to this pesticide.

SUMMARY OF ATRAZINE IN EPA REGION 6 SURFACE WATERS

EXECUTIVE SUMMARY

This report serves to summarize information and data on atrazine, a broadleaf herbicide. It represents a product of a work group formed at EPA Region 6, composed of representatives from the Source Water Protection Branch, the Ecosystems Protection Branch, Assistance Programs Branch, and the Pesticides Section. The mission of the work group is to more effectively address the occurrence of atrazine in surface waters of Region 6 and to determine if it constitutes a significant risk to human health and the environment. The work group was established in response to the findings of elevated levels of atrazine in selected water supplies in Texas and Louisiana.

Atrazine is the most widely used agricultural pesticide in the United States and is applied as a pre- and post-emergent herbicide particularly for corn and sorghum production. It is also used on sugarcane and wheat, and for treating turf and lawns. Atrazine enters lakes and streams through non-point source pathways. Atrazine has the potential to persist in the water column and bottom sediments. Available information suggests that the water bodies most vulnerable to atrazine contamination are within watersheds with a high proportion of agricultural land use.

In some source waters atrazine represent a possible risk to human health. Under the Safe Drinking Water Act (SDWA), EPA has established a Maximum Contaminant Level (MCL) of 3 micrograms per liter (ug/l) for atrazine which is applied as an annual average. This MCL is utilized for assessing compliance of drinking water systems. Under Section 303(d) of the Clean Water Act (CWA), the Texas Natural Resource Conservation Commission (TNRCC) assesses both ambient and finished drinking water data to determine whether the water supply use designated in the state surface water quality standards is attained. The TNRCC has identified Lake Aquilla as not attaining the water supply use due to violations of the MCL for finished drinking water. Nine additional water bodies were identified as threatened, having finished drinking water concentrations greater than one-half of the MCL. All of these water bodies are located in the north central Texas region.

Atrazine also represents a potential ecological concern as it is moderately toxic to fish and invertebrates. Adverse aquatic ecosystem structural and functional effects may occur at atrazine concentrations of 15 ug/l and above. EPA has established draft acute and chronic water quality criteria of 350 ug/l and 12 ug/l for freshwater, and 760 ug/l and 26 ug/l (acute and chronic) for saltwater. Atrazine does not readily bioaccumulate in aquatic organisms. EPA's CWA Section 305(b) guidelines recommend that partial support of the aquatic life use be assigned where acute or chronic criteria are exceeded more than once within a 3-year period, and non-support be assigned where these criteria are exceeded in more than 10% of the samples. Available information and data suggest a strong seasonal pattern of atrazine concentrations in ambient water, corresponding to application of the herbicide within the watershed. In watersheds with a high proportion of agricultural land use, chronic criteria exceedances have the potential to occur during or following spring rainfall events. Recent information suggest that atrazine may act as an endocrine disruptor, which could affect sexual development in frogs at very low concentrations ($\leq$0.1 ug/l).

The watersheds identified as threatened correspond closely to a Natural Resources Conservation Service (NRCS) relative ranking risk analysis which indicates that watersheds in north central Texas represent a higher risk for atrazine than other areas of Region 6. In general, there is a paucity of data for atrazine in ambient waters in Region 6. None of the Region 6 states routinely monitor atrazine as part of their fixed station ambient monitoring program. However, some states (e.g., Arkansas and Texas) monitor it periodically in certain waters or as part of special studies. Other data were collected by the U.S. Geological Survey (USGS) under the National Water Quality Assessment (NAWQA) Program. The USGS has found elevated atrazine concentrations in the Mississippi River, and the Louisiana Department of Environmental Quality (LDEQ) has found high concentrations in Terrebonne Parish, Louisiana. Recent monitoring by USGS and EPA found a watershed in the Ouachita basin, Louisiana, which did not meet the draft chronic national criterion of 12 ug/l.

Ambient data for atrazine is lacking for the majority of surface waters in Region 6. Most of the available data for Region 6 states was collected by the USGS. Monitoring in Texas is primarily focused on impaired and threatened waters. The Louisiana Department of Agriculture and Forestry conducts ongoing pesticide monitoring at selected ambient water quality stations throughout the state. Arkansas periodically monitors for atrazine (and other pesticides) as part of its ambient monitoring program. Additional monitoring programs and/or geographically focused studies would be useful to more clearly define the risk of atrazine to human health and the environment. Such monitoring should be designed to assess long-term concentrations and seasonal patterns of atrazine in ambient and finished drinking water. Data retrieved from STORET indicate that certain watersheds represent a higher risk to human health and the environment than others, particularly in the states of Louisiana and Texas.

EPA encourages the states and other organizations to integrate atrazine and other currently used pesticides into their existing monitoring and non-point source programs. These activities could include routinely reviewing drinking water data generated by the water supplies and implementing Best Management Practices (BMPs) through the Nonpoint Source Water Pollution Program to prevent impairment and to restore impaired watersheds. Special studies in higher risk watersheds would help to evaluate whether atrazine and other currently used pesticides represent a water quality problem.

BACKGROUND

Introduction

Atrazine, (CAS number 1912-24-9), is an herbicide widely used to control broadleaf weeds. It is the most widely used agricultural pesticide in the U.S. In the U.S., most atrazine is used for corn and sorghum production. It was first marketed to U.S. farms in 1959 and is still widely used today because it economically and effectively reduces crop losses due to weed competition. In 1991, nationwide, 51 million pounds of active ingredient of atrazine were applied to 40 million corn acres for an average rate of 1.3 pounds per acre (TSSWCB 2001). It is also used on sugarcane, wheat, and turf and lawns. Novartis Crop Protection is the major manufacturer of atrazine (EPA 1999). Pesticides such as atrazine are regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Before a pesticide may be sold or used in the U.S., EPA evaluates information on the pesticide to ensure that it will not cause “unreasonable adverse effects” to human health or the environment. Pesticides that pass this evaluation are granted a license or “registration” that permits their sale and use according to requirements set by EPA.

In Texas, atrazine is the pesticide most frequently detected in tap water provided from public drinking water supply systems. Atrazine can reach water supplies through run-off from fields and other application areas around lakes, streams or rivers. For the most part, atrazine is not removed from the water by conventional drinking water treatment systems. To remove atrazine from the water supply, a system would have to use powdered or granulated activated carbon filtration, at considerable expense (Texas Center for Policy Studies 1999).

In a national study of streams in the U.S., atrazine (or its degradation product, deethylatrazine or DEA) was among the herbicides detected more frequently (~80%) than other herbicides, with relatively high levels occurring as seasonal pulses in corn-growing areas. Average annual concentrations of atrazine were below 3 ug/l in all but one site (Larson et al. 1999; USGS 1999). In the Mississippi Embayment (which includes portions of Arkansas and Louisiana) study conducted by the USGS, the highest concentration of pre-emergent atrazine was frequently found early in the growing season (April-May) prior to planting grain and sorghum (Kleiss et al. 2000). Atrazine was detected in every sample collected from the Mississippi River and its major tributaries in April through June 1991 at concentrations ranging from 0.29 and 3.2 ug/l. Seasonal herbicide pulses occurred in response to rainfall after herbicides were applied to cropland. Atrazine exceeded the MCL concentration for one sample in Baton Rouge, Louisiana (Goolsby et al. 1991). In south-central Texas, atrazine and deethylatrazine were among the most commonly detected pesticides in agriculturally influenced, urban and “integrator” watersheds, although concentrations were relatively low, ranging from 0.0026 to 0.75 ug/l (Gin 1999; Bush et al. 2000). Seasonal pulses were apparent in agriculturally influenced streams, with peak levels in the spring (Ging 1999).

USGS found that among the pesticides monitored in groundwater, atrazine and deethylatrazine were the pesticides most frequently detected in various studies throughout the nation. In some watersheds groundwater flow may serve as a significant source of atrazine to surface waters (Barbash et al. 1999).

The purpose of this report is to summarize information and data on atrazine in surface waters in EPA Region 6

(Arkansas, Louisiana, New Mexico, Oklahoma and Texas). The report assesses data, highlights areas of concern, data gaps, and describes EPA-funded atrazine projects related to atrazine.

MCL Violations Nationwide and in Region 6

Under the Safe Drinking Water Act (SDWA), EPA establishes Maximum Contaminant Levels (MCLs) for pollutants that may be found in drinking water. The MCL for atrazine is 3 micrograms per liter (ug/l) for one year of quarterly samples (40 CFR 141.61). Water systems are responsible for monitoring finished drinking water to determine compliance with MCLs. If atrazine (or other organic contaminants regulated under the SDWA) is detected in finished drinking water, the system is required to monitor on a quarterly basis. The sampling frequency can be reduced if the system is consistently below the MCL (40 CFR 141.24).

According to the EPA Safe Drinking Water Information System (SDWIS) database, 109 public water systems in ten States have violated the maximum contaminant level (MCL) for atrazine from 1993 to 2000 (Table 1). Of these, 13 were ground water systems and 96 were surface water systems. Five systems in Texas violated the MCL. These systems received their water from Lake Aquilla, near Hillsboro, Texas.

Clean Water Act Section 303(d) Listings

Under Section 303(d) of the Clean Water Act (CWA), states are required to identify waters not meeting water quality standards utilizing available data and information. The Texas Natural Resource Conservation Commission (TNRCC) includes finished drinking water data into its routine 303(d) water quality assessment. Texas is the only Region 6 state which has included waterbodies on its 303(d) list due specifically to atrazine. Ten waterbodies were listed as threatened or impaired due to atrazine in finished drinking water (TNRCC 2000) (see Figure 1 and Table 2). These waterbodies are all located in the north central Texas area. In Texas, surface waters are categorized as impaired when the annual average atrazine concentration in finished water exceeds the MCL. Waters are categorized as threatened when detections in finished drinking water are above 50 percent of the MCL. For drinking water systems with nine or fewer samples, two or more must exceed 50 percent of the MCL to be considered threatened. For systems with more than nine finished water samples, 11 percent or more of the samples must exceed 50 percent of the MCL to be considered threatened (TNRCC 2002).

The state of Texas delisted segment 1242A, Marlin City Lake, the water supply for the city of Marlin. This lake was identified as threatened by atrazine on the 1998 303(d) list. The drinking water use is no longer threatened and instream data show a low probability of future atrazine exceedances. Best Management Practices (BMPs), including education, demonstration and training programs, are in place to reduce future runoff (TNRCC 2000). The Texas

State Soil and Water Conservation Board (TSSWCB) and the TNRCC have developed a Total Maximum Daily Load (TMDL) and Implementation Plan for atrazine in Lake Aquilla, which is the primary drinking water source for Hill County (TNRCC 2001; 2002). The annual running average atrazine concentration has exceeded 3 ug/l, thus, it is categorized as use-impaired. (TSSWCB 2001). Monitoring of water quality was conducted to assess non-point source contributions by subwatershed in Lake Aquilla and Marlin City Lake, although drought conditions considerably limited the quantity of data collected. The TSSWCB has also initiated "Atrazine Remediation Projects" utilizing Section 319 funding to implement BMPs for reservoirs threatened by atrazine, to reduce the likelihood for atrazine loads to result in actual use impairments. Finally, the TNRCC initiated a three-year monitoring project to assess atrazine levels over time in the threatened reservoirs in cooperation with the drinking water supplies. This monitoring program should aid in evaluating seasonal patterns and the overall effectiveness of BMP efforts which are underway in those reservoirs.

Other Region 6 states assess available atrazine data and information as part of the 303(d) listing process, although none have identified waters not meeting standards due to atrazine specifically. The states of Louisiana and Oklahoma have listed waters impaired due to pesticides, thus have the potential to include atrazine as a pollutant of concern. In response to these "generic" pesticide listings, EPA Region 6, through an Interagency Agreement (IAG) with the USGS, conducted ambient water column sampling for atrazine and numerous other pesticides in waterbodies listed for pesticides in the Ouachita basin, Louisiana. Atrazine was found to be a pollutant of concern in one water body in that basin, Big Creek. EPA drafted a TMDL for atrazine utilizing the draft national atrazine water quality criterion as the target. For other generic pesticides listings, review of existing data and/or ambient monitoring of appropriate pesticide compounds will be needed to determine which pesticides, if any, are not meeting narrative or numeric water quality standards, and therefore require development of TMDLs.

Concerns about Atrazine in Drinking Water

EPA has found atrazine to potentially cause a variety of health effects from exposures at levels above the MCL. These effects include: adverse effects on the heart, lungs and kidneys; hypotension; antidiuresis; muscle spasms; and weight loss. Atrazine has the potential to cause weight loss, cardiovascular damage, retinal and muscle degeneration, and mammary tumors from a lifetime exposure at levels above the MCL. There is also some evidence that atrazine may have the potential to cause cancer from a lifetime exposure at levels above the MCL (EPA 1995). However, EPA recently classified atrazine as "not likely to be carcinogenic to humans" (EPA 2001).

Ecological Concerns

Atrazine is relatively non-toxic to birds. The dose that is lethal to half of the exposed organisms (LD50) for mallard ducks is greater than 2,000 milligrams per kilogram (mg/kg) and at doses of 5,000 mg/kg no effect was observed in bobwhite quail and ring-necked pheasants (EXTOXNET 1996).

Atrazine is moderately to slightly toxic to fish and invertebrates. Table 3 lists acute and chronic toxicity values for selected freshwater and estuarine species. Chronic effect values for freshwater fish species range from 88.3 to 430 micrograms per liter (ug/l), with salmonids being most sensitive. The sheepshead minnow (an estuarine fish species) had a chronic effect value of 2,542 ug/l. Chronic effect values for freshwater invertebrates ranged from 159 to 3,500 ug/l, with the midge (Chironomus tentans) being most sensitive. Chronic effect values for estuarine invertebrates ranged from 123 to 20,900 ug/l, with mysids being most sensitive (EPA 2001).

Based on measured bioconcentration factors (BCFs) and values predicted from the soil adsorption coefficient, atrazine has a limited tendency to bioaccumulate in tissues of aquatic plants and animals (Howard 1991). BCFs ranged from <0.27 to 8.5 in three species of fish, and the BCF for Daphnia magna was <5 (EPA 2001).

Adverse aquatic ecosystem structural and functional effects have most frequently been observed at atrazine concentrations of 15 ug/l and above. However, adverse effects have been observed at lower exposure levels. Such effects have been on both the plant and animal communities, with the effects upon the animal community being secondary in nature as a result mainly of decreased availability of shelter and plant matter for food. The lowest reported EC50 for plants was for the unicellular alga, Selenastrum capriconutum (4 ug/l) and the lowest value for a vascular plant (duckweed, Lemna gibba) was 37 ug/l (U.S. EPA 2001). Ecological effects such as reduction in biomass and inhibition of photosynthesis have been found at concentrations as low as 0.1 ug/l. Levels of 20 ppb significantly affect the diet and reproductive success of bluegill and results in adverse effects on several species of insects, including reductions in species richness, total abundance of several species, and number of herbivorous insects (Uhler 1992).

The August 2001 draft EPA national criteria document for atrazine lists freshwater acute and chronic criteria for protecting aquatic life of 350 ug/l and 12 ug/l, respectively, and acute and chronic criteria for saltwater organisms of 760 ug/l and 26 ug/l (EPA 2001). EPA acute and chronic criteria represent one hour and four day average concentrations not to be exceeded more than once every three years. These criteria should be protective of both animals (invertebrates and fish) and plants (EPA 2001). The EPA Office of Water is coordinating with the Office of Pesticides on revisions to the document, which is expected to be finalized in the fall of 2002 (Frank Gostomski, EPA, personal communication).

New data suggest that atrazine may represent a serious ecological concern due to its endocrine disruptor characteristics. Hayes et al. (2002) found that African clawed frogs (Xenopus laevis) exposed to concentrations of atrazine ≥ 0.1 ug/l induced hermaphrodism. Exposure to higher concentrations (≥ 1 ug/l) demasculinized the larynges of exposed males, and testosterone levels decreased when exposed to 25 ug/l atrazine. These studies indicate that atrazine could have endocrine disruptor effects on native frog populations.

DRINKING WATER DATA

Texas Data

Texas Drinking Water System data from 1995 to 1999 was obtained from the TNRCC. Atrazine was detected in 85 of 1,162 (7.3%) Texas public water systems with surface water as the only source of water. Fifty four of the surface water systems with atrazine detections sold water to 353 other systems. Maximum atrazine concentrations for these systems ranged from 0.11 to 10.5 ug/l, with seven of the systems with detections at or above the MCL. Figure 2 is a map of the system locations in Texas. Table 4 lists the surface water systems with atrazine detections. Atrazine was detected in finished water in only 8 of the 5,500 (0.15%) Texas public water systems with groundwater as the only source of water. One of the ground water systems with atrazine detections sold water to one other public water system. Maximum atrazine concentrations ranged from 0.18 to 3.30 ug/l with only one system with a detection at or above the MCL. The population served by these public water supply systems with the potential for exposure to atrazine at or above the detectable limit is greater than 6.3 million.

Other States' Data

Atrazine analysis of finished drinking water is conducted in the other Region 6 states. However, this data is not currently available in an electronic format to EPA.

AMBIENT SURFACE WATER DATA

Upper Terrebonne Basin Study, Louisiana

In 1998 the Louisiana Department of Environmental Quality (LDEQ) and the Louisiana Department of Agriculture and Forestry (LDAF) undertook a joint atrazine sampling project in the Upper Terrebonne Basin because of concerns that atrazine could impact the drinking water of Iberville, Louisiana (LDEQ 1998). In 1998 sugarcane and corn crops comprised areas of 21,000 and 41,000 acres, respectively, within this 450,000 acre watershed. A total of

181 ambient samples were collected from 31 sample locations. Eighty-two (45.3%) of these samples exceeded the MCL of 3 ug/l atrazine. The highest concentration of 216.2 ug/l was collected in mid-April in Bayou Maringouin. Average atrazine concentrations for 21 of the 31 stations exceeded the MCL, seven of the sites never exceeded the MCL and, for three stations, atrazine was not found at or above the detection level of 1.0 ug/l. For numerous sites the data displayed a temporal pattern, with the highest concentrations being in March and April, and much lower concentrations being in May and June.

Bottom sediment samples were also collected at 30 sites on one date (April or June). Fourteen of the stations reported detectable concentrations of atrazine, while the remaining stations were below the minimum detection limit. Sediment levels ranged from 2.2 ug/kg (Bayou Stumpy) to 68.2 ug/kg (Bayou Maringouin), with an average concentration of 5.9 ug/kg. The project also included collection of effluent samples from seven municipal dischargers in the basin during the month of March. Atrazine was not detected in concentrations at or above the minimum detection level of 1.0 ug/l from any of the seven facilities.

Review of LDAF, USGS and EPA Ambient Data

EPA reviewed available ambient water pesticide monitoring data collected by the LDAF and the USGS for the Mermentau and Vermilion-Teche basins to determine where TMDLs were necessary. TMDLs are necessary where waters are not meeting narrative or numeric water quality standards. No exceedances of the draft atrazine water criteria for protection of aquatic life were found. The LDAF also routinely monitors ambient concentrations of a suite of pesticides in other basins in Louisiana. Several waterbodies within the Upper Terrebone Basin were found to have exceedances of the draft EPA chronic criterion of 12 ug/l. Data demonstrated that atrazine concentrations peaked in late March through mid-April. The more stringent MCL (3 ug/l) was not applicable to the assessment of ambient data since the waters sampled were not designated in the water quality standards as drinking water supplies.

In the spring and summer of 2001, EPA established an interagency agreement with the USGS-Louisiana District to collect samples from eighteen subsegments in the Ouachita basin identified as having pesticides concerns on the CWA Section 303(d) list of impaired waters. Because no specific pesticide compounds were identified, the samples were analyzed by the EPA Houston Laboratory for a suite of compounds including atrazine. Atrazine exceedances were found in one subsegment (detected concentrations 15.1 and 21.3 ug/l), Big Creek. Based on these results of this monitoring, a Total Maximum Daily Load (TMDL) for this waterbody was developed for this waterbody.

EPA conducted preliminary sampling for atrazine in the north Texas area utilizing two different laboratory methods (GC/MS and immunoassay). These results are presented in Appendix A. The values ranged from <0.1 to 0.41 ug/l (GC/MS) and 0.03 to 0.97 ug/l (immunoassay). Slightly higher levels utilizing the immunoassay protocol may be explained since the method analyzes atrazine and other structurally-related triazines additively.

Review of Ambient Data in the EPA STORET Database

Ambient water quality data contained in the STORET database were retrieved. Most data consisted of low or non-detected concentrations. The data where concentrations were $\geq$ 0.1 ug/l are presented in Table 5. The data retrieved were collected between 1995 (the beginning date specified) and 1998 (when Legacy STORET stopped receiving data). In most instances, sampling was very limited (one or two sampling events per station), and relatively extensive for a few stations in Louisiana and Texas.

In Arkansas, levels were relatively low, with the highest concentration being 0.87 ug/l. In Louisiana, several sites appeared to be problematic–waterbodies with average concentrations >1.0 ug/l included the Tensas River at Tendal (6.0 ug/l), the Red River at Alexandria (1.41 ug/l), and the Mississippi River at St. Francisville (1.03 ug/l). No stations in New Mexico reported values >0.1 ug/l, and in Oklahoma, only one station had a value >0.1 ug/l. In Texas, several waters had concentrations >1.0 ug/l, including Plum Creek near Lockhart (10.0 ug/l), Arroyo Colorado at Harlingen (1.45 ug/l), Big Onion Creek south of Bardwell (7.1 ug/l), Chambers Creek (two sites, 1.84 and 3.01 ug/l), Richland-Chambers Reservoir (three sites, 1.57 - 2.60 ug/l), Mill Creek at the Ellis/Navarro County Line (4.50 ug/l), and at Odem Ranch (2.35 ug/l).

Overall, the STORET data indicated that certain watersheds are a greater concern, probably those with a high agricultural influence. These waters include creeks, a reservoir and larger rivers, with the greatest prevalence in Louisiana and Texas.

NRCS MODEL FOR ATRAZINE RUNOFF

Using land use and soil data the USDA Natural Resource Conservation Service (NRCS) compared atrazine runoff risk among watersheds (Kellogg et al. 1998). NRCS constructed maps to show which watersheds had the greatest potential for the concentration of atrazine at the edge of the field to exceed the MCL of 3 ug/l. The report notes that the analysis does not show which watersheds are likely to exceed water quality standards. However, the analysis serves to provide a relative ranking of risk among watersheds.

Figure 3, which is derived from the NRCS analysis, shows the relative risk for atrazine in watersheds in Region 6. Watershed risk was estimated by calculating Threshold Exceedence Units (TEUs). The higher the TEU, the more risk for a watershed. Figure 3 indicates that the watersheds of central Texas which includes the reservoirs listed on the 2000 Texas 303(d) list are of higher risk for atrazine than other areas in Region 6.

EPA REGION 6 - FUNDED PROJECTS

A tabulation of EPA Region 6 - funded atrazine projects is presented in Appendix B. The state of Texas, through the TSSWCB and the TNRCC, Louisiana through the LDEQ, and Oklahoma through Office of the Secretary of the Environment to the Oklahoma Conservation Commission (OCC), have dedicated CWA Section 319 funds to quantify and remediate atrazine. Texas has implemented several projects designed to provide both financial and technical assistance to producers in the impacted watersheds through the development of water quality management plans (WQMPs). There are several recommended best management practices (BMPs) that are being identified for implementation through these WQMPs: contour farming, grass waterways, grass filter strips, strip cropping, terraces, incorporate atrazine, rotary hoe and cultivation for weed control, crop rotation, setback areas, no-till farming, split applications, focus on post-emergence application, band application, avoid wet soil application, no application in high-risk situations.

EPA's primary grantees for funding to control atrazine have been the TSSWCB, TNRCC, OCC, and the LDEQ. Presently in Texas, the TSSWCB has used $4,255,675 of its Section 319 funding to address atrazine through studies and implementation of WQMPs, while TNRCC has used $157,150 to study the prevalence of numerous chemicals, including atrazine, in the groundwater of the Edwards Aquifer. LDEQ has dedicated $170,031 of its federal funds to improve water quality in the Upper Terrebonne basin from atrazine due to farm practices and compare concentration of atrazine in surface water runoff from sugarcane. OCC has used $280,441 of its federal funds to sample for several parameters, including pesticides and herbicides such as atrazine in the many seeps of Oklahoma's western central region. This has meant a total state match of $2,536,067 has been contributed by these states, for a total of $7,399,364 being spent on federal and state funds to manage atrazine. TSSWCB has submitted preliminary draft workplans for further atrazine work for fiscal year 2002 Section 319 funding. Their proposed amount for atrazine management in 2002 is $108,000 federal, but expect to put together a final workplan that would use $550,000 federal, $330,000 as match, for a total of $880,000. This will be targeted for the Little River watershed. The proposed work has not been included in Appendix B.

DATA GAPS

Data gaps are apparent from both spacial and temporal standpoints. The states do not conduct routine ambient surface monitoring for atrazine. States should consider incorporating atrazine into their ambient monitoring programs in urban and agricultural watersheds. Routine monitoring over time will provide some indication of seasonal variation. However, even limited baseline monitoring in the spring season would aid in assessing potential risks and for deciding where more intensive sampling may be appropriate. This type of sampling has been conducted to varying degrees in all five Region 6 states, primarily by state water resource agencies or the USGS..

Periodic monitoring in high risk watersheds is advisable.

Data gaps also exist for finished drinking water. States need to consider data collected by the individual water supplies in their water quality management programs. Texas' ambient data assessment procedures (TNRCC 2002) include guidelines for assessing finished drinking water data and the state makes use impairment determinations based on the data. This is facilitated through the use of an electronic finished drinking water database. Most larger water supplies monitor atrazine quarterly, however, data gaps exist for the smaller water supply systems, and data collected on a frequent basis to assess concentration patterns are lacking. Possible studies to improve assessment of risks related to atrazine and which may aid one or more water supplies or states are provided in Appendix B.

CONCLUSIONS

An EPA Region 6 work group was formed consisting of staff from the Ecosystems Protection Branch, Source Water Protection Branch, Assistance Programs Branch, and the Pesticides Section. The work group served to improve the Region's understanding of water quality issues related to atrazine, in which cross-program coordination was needed. This report, in an encapsulated form, presents the results of a review of data and information related to atrazine in Region 6. One such water quality problem which demonstrated a need for cross program involvement was Lake Aquilla, located in north central Texas. The TNRCC has identified this reservoir as having the drinking water use impaired and nine other water bodies with the drinking water use threatened under Section 303(d) of the Clean Water Act. The occurrence of atrazine in drinking waters corresponds with a risk analysis of surface water conducted by NRCS which identifies north central Texas as having a higher potential for atrazine contamination than other areas within Region 6. The NRCS model utilizes land use and soil type to establish relative risk.

Atrazine is relatively persistent and, due to it's slow breakdown, water column concentrations may become elevated in lakes, particularly those with watersheds having a high proportion of agricultural corn production. It does not strongly associate with soil or sediment particles which likely facilitates loading through nonpoint source pathways. Atrazine is utilized as a pre- and post-emergent pesticide. Applications in this Region begin in late February and continue into May. Ambient water data indicate a widespread occurrence of atrazine at relatively low concentrations, with strong seasonal peaks in agriculturally influenced lakes and streams in response to Spring rainfall. These peaks may pose a risk to aquatic life residing in these lakes and streams. Risk to human health is more reflective of temporal average concentrations of atrazine. Other than quarterly monitoring by municipal water supplies, and a special monitoring study presently underway in Texas, temporal data for finished and ambient waters are lacking.

In addition to corn and sorghum, atrazine is also utilized on sugarcane and residential lawns as a weed control agent. Thus, watersheds influenced by the production of sugarcane and highly populated watersheds may be at higher risk.

Data for Terrebonne Basin, Louisiana collected by the Louisiana Department of Environmental Quality supports the association in surface water with sugarcane production. While this review focused on surface water, groundwater contamination, particularly in Louisiana may be a concern for drinking water supplies relying on groundwater, as well as where groundwater may serve as a conduit to surface water. This review points out the need for the States and EPA to ensure that atrazine is being applied properly, to protect water quality and prevent impairment It also stresses the need to adequately monitor atrazine levels in high risk watersheds, and to develop TMDLs and implement BMPs in watersheds demonstrating elevated concentrations.

RECOMMENDATIONS

The findings of this review support the following recommendations:

1. EPA and the states are encouraged to coordinate on a cross-program basis to address atrazine, particularly as it relates to the potential for water quality impairment. Coordination is needed in the development of water quality standards, the development of TMDLs and the implementation of BMPs to restore water quality, and prevent impairment.

2. EPA and the states are encouraged to increase the level of monitoring conducted in the Region, particularly in agricultural and urban areas of higher relative risk. This could include adding atrazine (and other pesticides in current use) in state ambient monitoring programs, and/or conducting screening level (baseline) monitoring studies. Monitoring water supplies and finished drinking water are important to assess possible risks to human health. Monitoring other types of waterbodies in agriculturally influenced watersheds is advisable to assess ecological risks to aquatic life, particularly during the Spring season when applications of atrazine and runoff are expected to be highest.

3. EPA and the states should evaluate the adequacy of existing FIFRA regulations applicable to atrazine to assure protection of water quality, and implement Best Management Practices (BMPs) through the Nonpoint Source Program to address loading in high risk watersheds.

4. EPA and the states are encouraged to share atrazine and other data for raw and finished drinking water. The states should develop electronic protocols to facilitate access to electronic sources of drinking water data. The data should be reviewed by the states and EPA Region 6 to identify water bodies where the drinking water use may be impaired or threatened to determine if particular management actions are appropriate.

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Tables

Table 1. Atrazine MCL Violations from the EPA SDWIS Database, 1993-2000.

STATE	Ground Water Systems	Ground Water Violations	Surface Water Systems	Surface Water Violations	Total Systems	Total Violations
Iowa	0	0	1	1	1	1
New York	1	1	0	0	1	1
Wisconsin	1	5	0	0	1	5
Ohio	0	0	2	2	2	2
Pennsylvania	2	2	0	0	2	2
Texas	0	0	5	5	5	5
Indiana	0	0	6	10	6	10
Kansas	1	1	7	7	8	8
Missouri	0	0	11	20	11	20
Illinois	8	27	64	226	72	253
TOTALS	13	36	96	271	109	307

Table 2. Waterbodies in Texas Included in the State's 2000 Clean Water Act Section 303(d) List Due to Atrazine.

Segment No.	Waterbody Name	Type of Use Impairment
0303A	Big Creek Lake	Threatened
0507	Lake Tawakoni	Threatened
0815	Bardwell Reservoir	Threatened
0816	Lake Waxahatchie	Threatened
0817	Navarro Mills Reservoir	Threatened
0821	Lake Lavon	Threatened
0836	Richland-Chambers Reservoir	Threatened
0838	Joe Pool Lake	Threatened
1213	Little River	Threatened
1254	Aquilla Reservoir	Impaired*

*This waterbody is also listed for alachlor (threatened).

Table 3. Acute and Chronic Toxicity Values for Selected Freshwater and Estuarine Species (from EPA 2001).

Species	Concentration in ug/l Acute Value	 Chronic Value	Acute to Chronic Ratio
Cladoceran (Ceriodaphnia dubia)	30,000	3,500	>8.571
Fathead Minnow (Pimephales promelas)	15,000	430	34.88
Copepod (Eurytemora affinis)	13,200	5,010	2.635
Bluegill (Lepomis macrochirus)	>8,000	218	>36.7
Cladoceran (Daphnia magna)	6,900	187	36.9
Sheepshead Minnow (Cyprinodon variegatus)	5,660	2,542	2.226
Midge (Chironomus tentans)	720	159	4.528

Table 4. Texas Public Water Systems Using Surface Water Only Detecting Atrazine, 1995-1999.

SYSTEM NAME	PWS ID NUMBER	MAXIMUM LEVEL (PPB)
AQUILLA WATER SUPPLY DISTRICT	1090068	10.50
MARLIN CITY OF	0730002	9.60
CORSICANA CITY OF	1750002	8.40
TAYLOR CITY OF	2460004	5.40
COMBINED WATER SUPPLY CORP, QUINLAN	1160052	4.00
FT WORTH CITY OF	2200012	3.10
COOPER CITY OF	0600001	3.00
WAXAHACHIE CITY OF	0700008	2.90
MANSFIELD CITY OF	2200018	2.60
NORTH TEXAS MUNICIPAL WATER DIST	0430044	2.50
ENNIS CITY OF	0700001	2.40
CAMERON CITY OF	1660001	2.20
WEST TAWAKONI CITY OF	1160012	2.00
ARLINGTON CITY OF	2200001	1.80
POINT CITY OF	1900004	1.53
LEWISVILLE CITY OF	0610004	1.50
GROESBECK CITY OF	1470002	1.36
LIVINGSTON REGIONAL WATER SUPPLY	1870129	1.20
STERLING CHEMICALS INC-TX CITY PLA	0840019	1.20
TARRANT REGIONAL WATER DISTRICT	0810035	1.20
DALLAS WATER UTILITY	0570004	1.14
GULF COAST WTR AUTHORITY- TX CITY	0840153	1.13
BRAZOSPORT WATER AUTHORITY	0200497	1.04
INTERNATIONAL PAPER COMPANY, TEXARKANA	0340005	0.92
S L C WATER SUPPLY CORP, GROESBECK	1470031	0.84
CASH WATER SUPPLY CORPORATION, GREENVILLE	1160018	0.80
DALLAS COUNTY PARK CITIES MUD	0570078	0.80
EMORY CITY OF	1900001	0.80
GREENVILLE CITY OF	1160004	0.78
MAC BEE WATER SUPPLY CORP, WILLS POINT	2340012	0.72
PARIS CITY OF	1390002	0.69
WACO CITY OF	1550008	0.65
ANAHUAC CITY OF	0360001	0.60
BAYTANK HOUSTON INCORPORATED	1012008	0.60
DIANAL AMERICA INCORPORATED, PASADENA	1012841	0.60
MONTELL POLYOLEFINS-BAYPORT PLANT	1011568	0.60
TRA-HUNTSVILLE	2360058	0.60
WILLS POINT CITY OF	2340005	0.60
SULPHUR SPRINGS CITY OF	1120002	0.59
TRA-TARRANT CO WATER PROJECT	2200199	0.56
SOUTH TAWAKONI WATER SUPPLY CORP	2340019	0.51
GRAPEVINE CITY OF	2200013	0.50
WHITE RIVER MUNICIPAL WATER DIST, SPUR	0540015	0.50

Table 4 (continued).

SYSTEM NAME	PWS ID NUMBER	MAXIMUM LEVEL (PPB)
LYFORD CITY OF	2450003	0.41
BAYTOWN AREA WATER AUTHORITY	1011742	0.40
GATESVILLE CITY OF	0500002	0.40
TEMPLE CITY OF	0140005	0.40
BELL COUNTY WCID NO 1	0140016	0.39
BLUEBONNET WATER SUPPLY CORP, TEMPLE	0140162	0.38
TBCD - OAK ISLAND & DOUBLE BAYOU, ANAHUAC	0360018	0.35
SOLUTIA INC-CHOCOLATE BAYOU PLANT	0200049	0.34
PRESTON SHORES WATER SYSTEM, GRAYSON CO.	0910037	0.33
MABANK CITY OF	1290005	0.30
TEXARKANA WATER UTILITIES	0190004	0.30
WORTHAM CITY OF	0810003	0.30
WEST CEDAR CREEK MUNICIPAL UTILITY	1070190	0.29
ARROYO WATER SUPPLY CORPORATION, RIO HONDO	0310031	0.28
GBRA - PORT LAVACA	0290005	0.28
MACKENZIE MUNICIPAL WATER AUTH	0230004	0.28
POINT COMFORT CITY OF	0290001	0.25
KEMP CITY OF	1290004	0.24
BROWNSVILLE PUBLIC UTILITY BOARD	0310001	0.23
WEST JEFFERSON COUNTY MWD	1230021	0.23
US DENRO STEELS INC, BAYTOWN	0360040	0.22
EAST CEDAR CRK FWSD - BROOKSHIRE	1070167	0.19
UNION CARBIDE - SEADRIFT PLANT	0290003	0.19
VALLEY MUD NO 2 RANCHO VIEJO	0310059	0.19
LONGVIEW CITY OF	0920004	0.18
STAR HARBOR CITY OF	1070150	0.18
TBCD - H E W, ANAHUAC	0360030	0.18
THREE RIVERS CITY OF	1490002	0.18
BONHAM CITY OF	0740001	0.17
EAST CEDAR CREEK FWSD - B A MCKAY, MABANK	1070019	0.17
EAST RIO HONDO WATER SUPPLY CORP	0310096	0.17
SAN PATRICIO MUNICIPAL WATER DIST	2050011	0.17
CAROLYNN ESTATES, HENDERSON CO.	1070106	0.16
HUXLEY CITY OF	2100019	0.16
SEADRIFT COKE LP	0290054	0.16
TERRELL CITY OF	1290006	0.16
UPPER LEON R MUNICIPAL WATER DIST	0470015	0.16
BP CHEMICALS INCORP - GREENLAKE	0290051	0.13
LA VILLA CITY OF	1080023	0.13
RIO HONDO CITY OF	0310006	0.13
NUECES COUNTY WCID NO 3	1780005	0.12
ALICE CITY OF	1250001	0.11

Table 5. Ambient Monitoring Stations with Mean Concentrations of Atrazine >0.1 Contained in the EPA STORET Database for the Region 6 states of Arkansas, Louisiana, New Mexico, Oklahoma and Texas (1995-98).

Station No.	Location	Mean Conc. (ug/l)	No. of Samples
Arkansas			
050083	Arkansas R. at Lock & Dam No. 2	0.40	1
05UWS042	Little Lagrue B. at Hwy 1 near Dewitt	0.25	2
050126	Arkansas R. at Lock & Dam No. 9 near. Opello	0.46	1
050120	St. Francis R. at Lake City	0.30	1
05UWS040	Bayou Bartholomew at Hwy. 4 near McGee	0.12	2
050125	Arkansas River at Lock & Dam No. 8	0.44	1
050128	Arkansas River at Ozark Lock and Dam	0.37	1
05UWS009	Cache R. at Hwy. 18 near. Gruggs	0.19	2
05UWS009	Village Creek at Hwy 37, 3 Miles east of Tucker	0.14	2
0UWS023	Village Creek at Hwy 224 Nr. Newport	0.18	2
050102	Bayou Meto near Bayou Meto	0.14	1
050079	Arkansas River at Lock & Dam No. 4	0.39	1
050080	Arkansas R. at Lock & Dam No. 5	0.43	1
05UWS051	Plum Bayou 1 Mi. west of Hwy 15 near Tucker	0.44	1
050122	L'Anguille R. near Marianna	0.28	1
050137	Red R. south of Foreman	0.23	1
050284	Bayou Two Prairie at Hwy 13 south of Carlisle	0.47	1
050024	Sulphur R. south of Texarkana	0.60	1
050123	Days Creek southeast of Texarkana	0.11	1
050114	Cache Creek at Brasfield	0.22	1
050166	Little Missouri R. near Boughton	0.11	1
050127	Arkansas R. near Dardanelle	0.42	1
050183	Des Arc Bayou near Mouth	0.15	1

Table 5 (Continued)

Station No.	Location	Mean Conc. (ug/l)	No. of Samples
07263620	Arkansas R.at David D. Terry Lock & Dam	0.30	1

050124	Arkansas R. at Murray Lock & Dam		0.31	1
050056	Arkansas R. at David T. Terry Lock & Dam	0.37		1
050218	St. Francis R. at Madison		0.87	1
050132	Arkansas R. at Van Buren		0.40	1
05UWS004	Bayou Des Arc County Rd. above Cypress Bayou		0.15	1
05UWS006	Bayou Deview at Hwy. 64 east of McCroy		0.27	1
05UWS007	Cache R. at Hwy. 64 near Patterson	0.26		2

<u>Louisiana</u>

07380500	Bayou LaFourche at Napoleonville		0.19	1
293848090321200	Bayou LaFourche near Norah		0.24	1
293418090225400	Bayou LaFourche near Cutoff		0.25	1
293408090230300	ICWW west of Larose		0.65	1
293414090225100	Bayou LaFourche below Larose		0.69	1
293439090225500	ICWW east of Larose		0.66	1
294800090490600	Bayou LaFource at Thibidaux		0.65	1
07369500	Tensas River at Tendal		6.00	8
050092	Boeuf River near Arkansas State Line		0.78	1
07374550	Mississippi River at Venice		0.43	11
07381495	Atchafalaya River at Melville		0.92	20
07355000	Red River at Alexandria		1.41	2
07374400	Mississippi River at Luling		0.48	10
07381590	Wax Lake Outlet at Calumet		0.36	14
07381600	Lower Atchafalaya River at Morgan city		0.36	14
07373420	Mississippi River at St. Francisville	1.03		22

Table 5 (Continued)

Station No.	Location	Mean Conc. (ug/l)	No. of Samples

<u>New Mexico</u>

No stations with concentrations >0.1 ug/l

Oklahoma

07241520	North Canadian River at Britton Rd., OKC	0.13	6

Texas

08172500	Plumb Creek near Lockhart	10.0	1
08470400	Arroyo Colorado at Harlingen	1.45	11
08057410	Trinity River below Dallas	0.54	8
08057200	White Rock Creek at Greenville Ave., Dallas	0.52	7
321313096415201	Big Onion Creek on FM 985 south of Bardwell	7.1	6
321441096442601	Chambers Creek on FM 876	1.84	7
315807096054899	Richland-Chambers Reservoir at Dam	1.8	2
08074500	Whiteoak Bayou at Houston	0.72	6
08075500	Sims Bayou at Houston	0.33	4
08076000	Greens Bayou near Houston	0.40	5
08075770	Hunting Bayou at IH610	0.24	5
08212900	Tunas Creek near Kingsville	0.32	1
08212600	Upper Chiltipin Canal near Kingsville	0.93	1
08202790	Parkers Creek Reservoir inflow near Dhanis	0.15	8
08202900	Seco Creek near Yancey	0.10	6
08064100	Chambers Creek	3.01	8
315801096282999	Richland Creek on Gravel road near Richland	1.89	7
315815096114399	Richland-Chambers Reservoir-Confl. of arms	2.60	1
315821096152299	Richland -Chambers Reservoir-Richland arm	1.76	2
320228096122999	Richland-Chambers Reservoir-Chambers arm	1.57	2
321017096420099	Mill Creek at Ellis/Navarro County line	4.50	6

Table 5 (Continued)

Station No.	Location	Mean Conc. (ug/l)	No. of Samples
275707097430500	Odem Ranch site 1	0.29	2

275845097424300	Odem Ranch site 2	2.35	2
08048542	Sycamore Creek at Sycamore Park	0.29	7
324007097110199	Kee Branch at Bardin Road, Arlington	0.30	1
324407097052499	Johnson Creek at Abrams St., Arlington	0.23	8
325114097092199	Sulphur Branch at Harwood Rd., Bedford	0.59	1
08155240	Barton Creek at Lost Creek Blvd. near Austin	0.10	1

Figures

Figure 1. Waters on the Texas Clean Water Act Section 303(d) List Due to Atrazine.

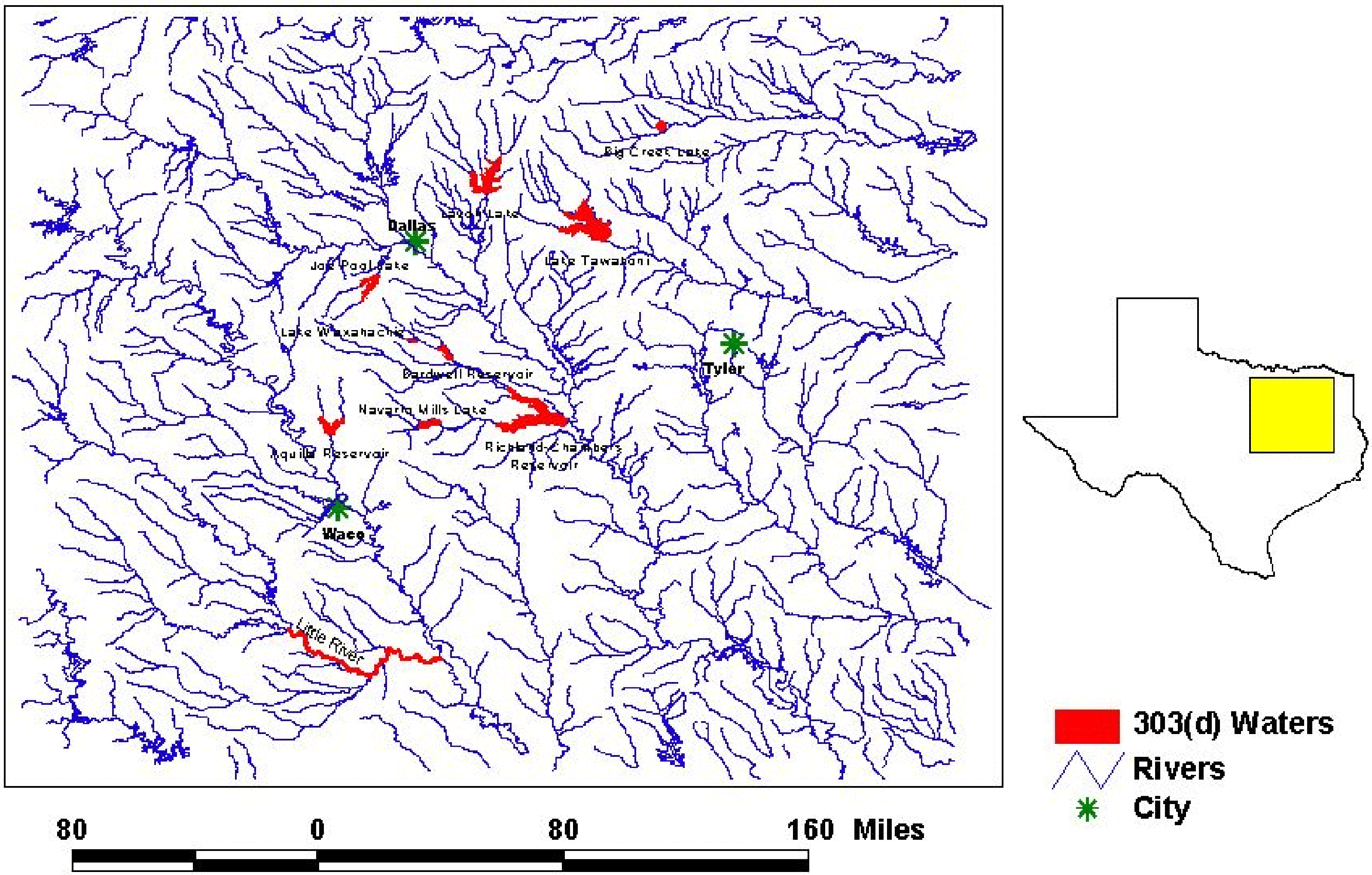


Figure 2. Texas Public Water Systems Using only Surface Water with Atrazine Detections.

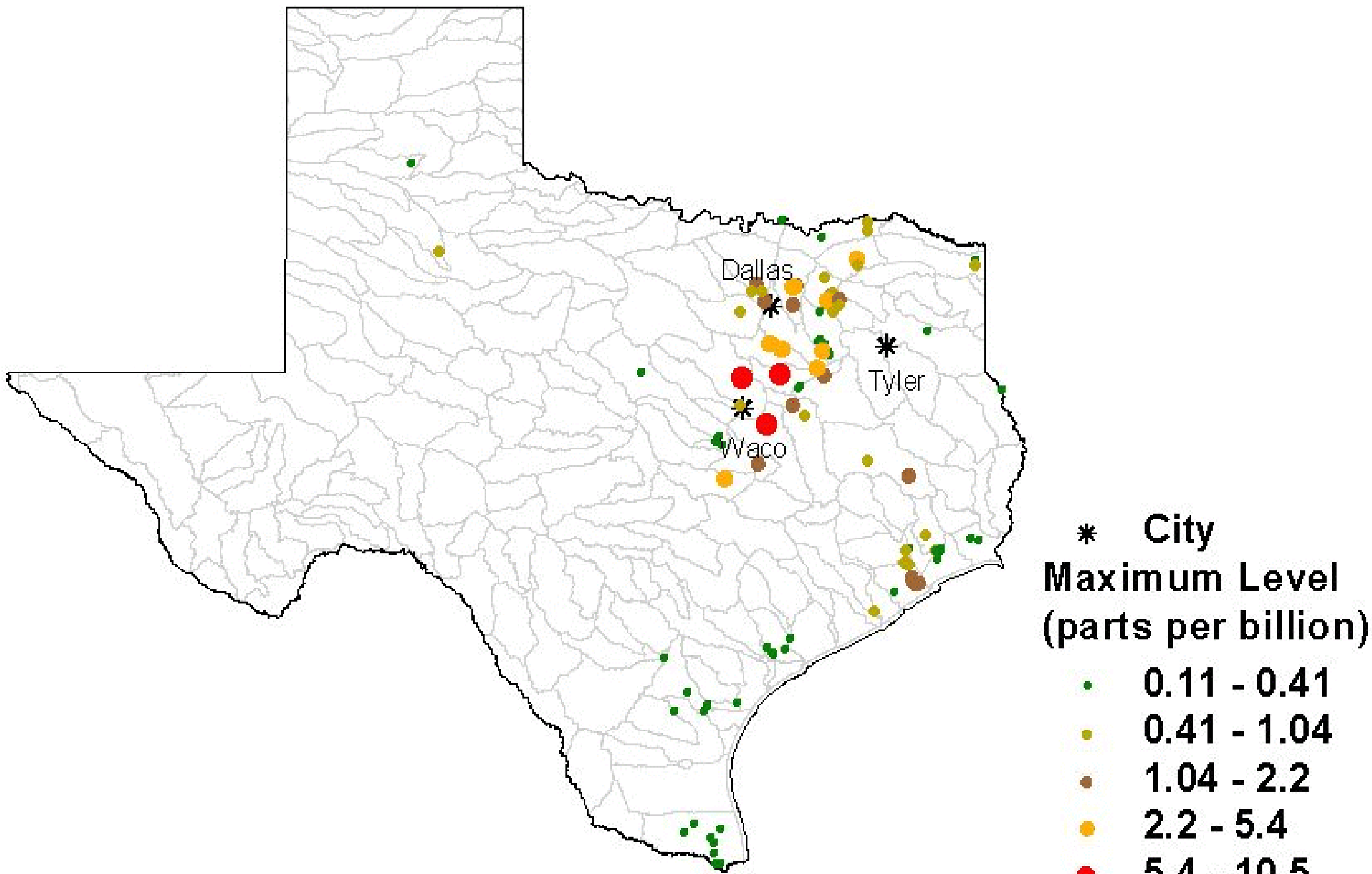


Figure 3. Potential for Atrazine Runoff at the Edge of the Field to Exceed EPA's MCL (3 ppb).*

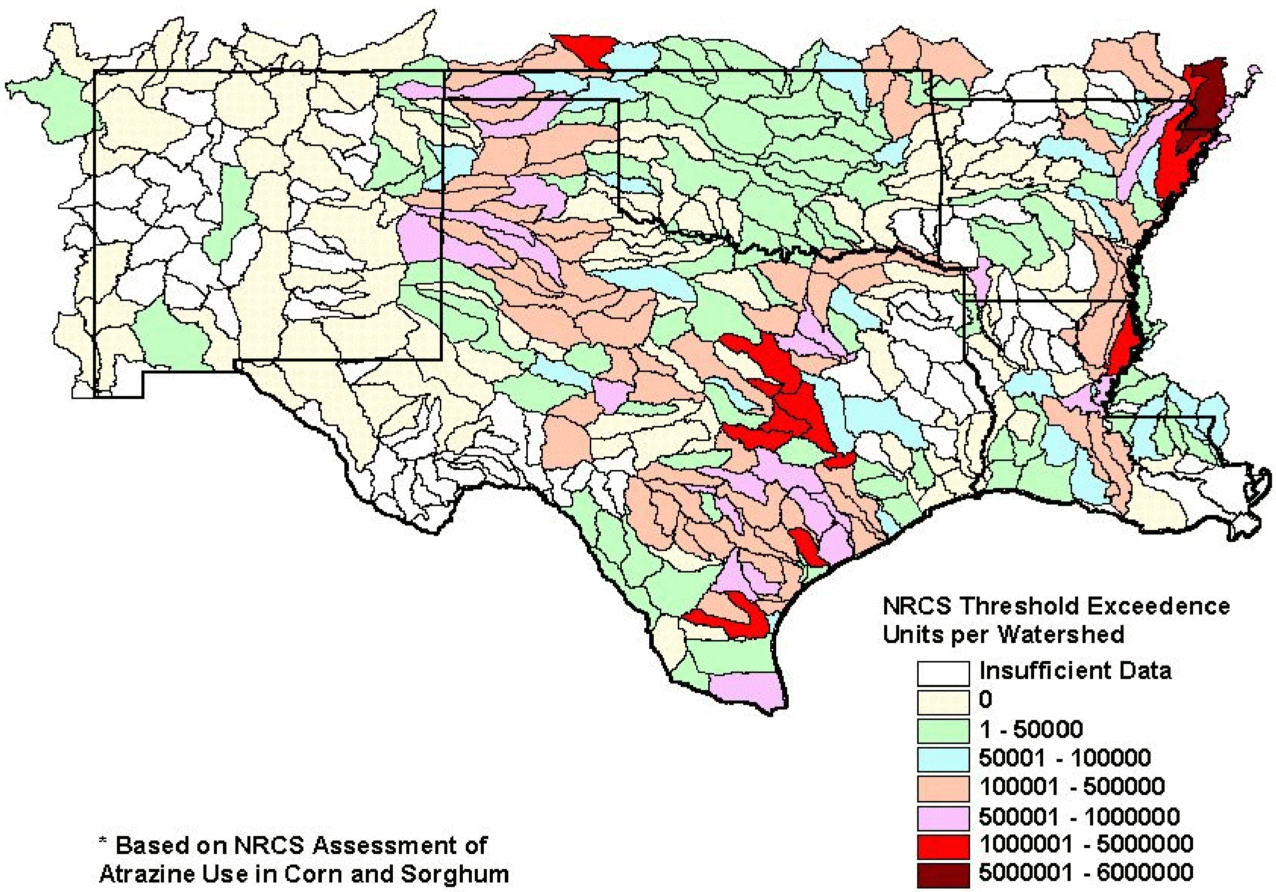
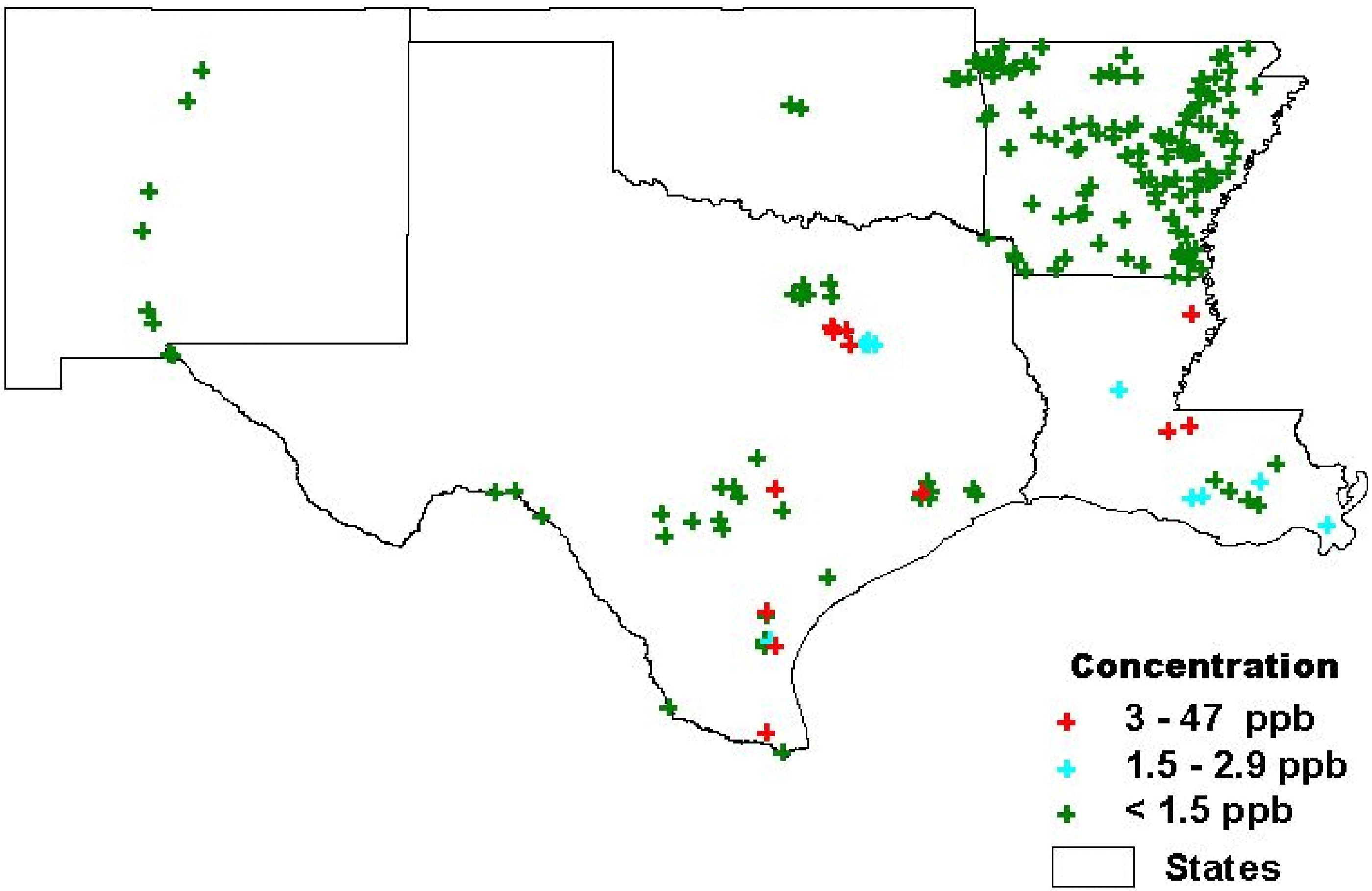


Figure 4: Monitoring Events with Atrazine Detects in Region 6 States Using STORET Data (Maximum Values Shown).



STORET data retrieved from 1/1/95 to 9/29/98

Appendices

Appendix A

EPA Preliminary Sampling for Atrazine in North Texas

On April 24, 2000, EPA did some initial exploratory sampling for atrazine in conjunction with sampling work being done by the University of North Texas. Single sampling events were conducted for the Elm Fork below Lake Ray Roberts, Lake Ray Roberts at the dam, Indian Creek below Lake Kiowa, Elm Fork below Lake Ray Roberts and Spring Creek at I35. These samples were analyzed by the EPA Regional Laboratory in Houston by GC/MS, Method 525.2 and/or Immunoassay, Method 4670. The results obtained were as follows:

Site Location	Atrazine Concentration (ug/l)	
	Method 525.2	Method 4670*
Elm Fork below Lake Ray Roberts	0.41	0.56
Lake Ray Roberts at Dam	0.40	0.97
Elm Creek above Lake Ray Roberts	NA*	0.03
Indian Creek below Lake Kiowa	<0.1	0.06
spring Creek at I35 in Valley View	NA	0.36

*NA - not analyzed

These results indicate the presence of atrazine at low levels (<1 ug/l) at several locations within the Lake Ray Roberts watershed. The immunoassay method results showed higher results than the GC/MS results for two of the three sites where side-by-side analyses were conducted. This likely reflects the fact that the immunoassay method analyzes atrazine and other structurally-related triazines, thus producing an additive concentration (Musick et al. 2000).

Appendix B

EPA Region 6 - Funded Atrazine Projects

Information on EPA Region 6 - funded projects is presented in the table below. The table, which is accurate through December 2001, includes various project titles, local project leads, project goals, effected watersheds, funding summary, and the number of water quality management plans (WQMPs) developed, certified by an agency engineer, and minimum amount to be developed according to the approved workplan. Several of these projects do not have numbers attached as of yet since many of these are just getting underway. Under the funding column, the symbols used are defined as F=federal, M=match, T=total.

TEXAS ATRAZINE PROJECTS

Project Title	Project Goals	Funding	WQMPs*
The North Texas Atrazine Remediation Project Lead - Limestone Falls SWCD*	Submitted by the TSSWCB – This project will provide corn and sorghum producers in the Richland Chambers Reservoir with financial/technical assistance for BMP implementation aimed at reducing atrazine runoff, and will provide water quality educational activities.	F-$130,849 M-$87,232 T-$218,081	Dev – 9 Cert – 5 Min - 5
The North Central Texas Atrazine Remediation Project Lead – Hill, Blackland, and Johnson SWCDs	Submitted by the TSSWCB – This project will provide corn and sorghum producers in the Aquilla and Richland Chambers Reservoir watersheds with financial/technical assistance for BMP implementation aimed at reducing atrazine runoff, and will provide water quality educational activities.	F-$1,440,600 M-$960,400 T-$2,401,000	Dev- 44 Cert- 25 Min - 70
The North Central Texas Atrazine Remediation project Lead – Navarro SWCD	Submitted by the TSSWCB – This project will provide corn and sorghum producers in the Richland-Chambers Reservoir watershed with financial/technical assistance for BMP implementation aimed at reducing atrazine runoff, and will provide water quality educational activities.	F-$404,200 M-$269,467 T-$673,667	Dev- 13 Cert - 2 Min - 25
The North Central Texas Atrazine Remediation project Lead – Dalworth SWCD	Submitted by the TSSWCB – This project will provide corn and sorghum producers in the Joe Pool Lake Reservoir watershed with financial/technical assistance for BMP implementation aimed at reducing atrazine runoff, and will provide water quality educational activities.	F-$93,849 M-$62,566 T-$156,415	Dev - 4 Cert – 1 Min - 5
The North Central Texas Atrazine Remediation project Lead – Ellis - Prairie SWCD	Submitted by the TSSWCB – This project will provide corn and sorghum producers in the Joe Pool Lake, Lake Waxahachie, and Bardwell Reservoir watersheds with financial/technical assistance for BMP implementation aimed at reducing atrazine runoff, and will provide water quality educational activities.	F-$456,700 M-$304,467 T-$761,167	Dev – Cert – Min -30
The North Texas Atrazine Remediation project Lead – Collin Co. SWCD	Submitted by the TSSWCB – This project will provide corn and sorghum producers in the Lake Lavon, Lake Tawakoni, and Big Creek Lake watersheds with financial/technical assistance for BMP implementation aimed at reducing atrazine runoff, and will provide water quality educational activities.	F-$404,200 M-$89,583 T-$493,783	Dev – Cert – Min - 25
The North Texas Atrazine Remediation project Lead – Hunt Co. SWCD	Submitted by the TSSWCB – This project will provide corn and sorghum producers in the Lake Lavon, Lake Tawakoni, and Big Creek Lake watershed with financial/technical assistance for BMP implementation aimed at reducing atrazine runoff, and will provide water quality educational activities.	F-$540,700 M-$136,166 T-$676,866	Dev – Cert – Min - 35
The North Texas Atrazine Remediation project Lead - Kaufman Van-Zandt SWCD	Submitted by the TSSWCB – This project will provide corn and sorghum producers in the Lake Lavon, Lake Tawakoni, and Big Creek Lake watersheds financial/technical assistance for BMP implementation aimed at reducing atrazine runoff, and will provide water quality educational activities.	F-$93,849 M-$17,916 T-$111,765	Dev – Cert – Min - 5
The North Texas Atrazine Remediation project Lead - Fannin SWCD	Submitted by the TSSWCB – This project will provide corn and sorghum producers in the Lake Lavon, Lake Tawakoni, and Big Creek Lake watersheds with financial/technical assistance for BMP implementation aimed at reducing atrazine runoff, and will provide water quality educational activities.	F-$246,700 M-$35,833 T-$282,533	Dev – Cert – Min - 10

The North Texas Atrazine Remediation project Lead – Upper Elm-Red SWCD	Submitted by the TSSWCB – This project will provide corn and sorghum producers in the Lake Lavon, Lake Tawakoni, and Big Creek Lake watersheds with financial/technical assistance for BMP implementation aimed at reducing atrazine runoff, and will provide water quality educational activities.	F-$246,700 M-$35,833 T-$282,533	Dev – Cert – Min - 10
Lake Aquilla & Marlin City Lakes System-WQAP Lead-TAES-Blackland Research & Extension Center	Submitted by the Texas Agricultural Experiment Station through the TSSWCB - This project provided water quality educational activities, implemented best management practices (BMPs), and monitored the major tributaries and reservoirs for atrazine contamination.	F-$197,328 M-$131,522 T-$328,850 (Completed)	N/A
Water Quality & Flow Loss Study, Edwards Aquifer Lead – Barton Springs/ Edwards Aquifer Conservation District	Submitted by TNRCC – Many land use changes are occurring in the Barton Springs portion of the Edwards aquifer. This study is to provide a comprehensive groundwater baseline of the area to see if these land use changes are having a detrimental impact on the aquifer. Numerous constituents are being monitored, including atrazine.	F-$157,150 M- $104,767 T- $261,917	N/A
Total for Texas		F-$4,412,825 M-2,235,752 T-$6,648,577	Dev – 70 Cert – 33 Min - 220

LOUISIANA ATRAZINE PROJECTS

Project Title	Project Goals	Funding	WQMPs
Fate of Atrazine Herbicide in Soils as Affected by Sugar Cane Management- LSU-Ag Experiment Station	Submitted by LDEQ to fund Louisiana State University's (LSU) Agriculture Experiment Station. This project takes place in the Upper Terrebonne River Watershed. Its objectives are to improve water quality in the Upper Terrebonne Parish from atrazine due to farm practices; compare concentration of atrazine in surface water runoff from sugarcane grown under conventional methods; obtain quantifiable surface water data on concentration of atrazine and metribuzine present in Surface runoff when BMPs are used; make recommendation on BMP that is effective at reducing atrazine runoff; education and outreach.	F-$170,031 M-$113,354 T-$283,385	N/A
Total for Louisiana		F-$170,031 M-$113,354 T-$283,385	

OKLAHOMA ATRAZINE PROJECTS

Project Title	Project Goals	Funding	WQMPs
Technical Assistance to Improve the Quality of Ground Water-Surface Water Interactions Lead – Oklahoma Conservation Commission (OCC) and Oklahoma State University Cooperative Extension Service (OCES)	Submitted by the Oklahoma Office of the Secretary of Environment – This project had a sampling component (OCC) which sampled for several parameters, including pesticides and herbicides such as atrazine in the many seeps of the area. It also included an educational component (OCES) demonstrating to producers Integrated Pest Management techniques, proper pesticide sprayer use and calibration, and alternative herbicide application routines.	F-$280,441 M-$186,961 T-$467,402	NA
Total for Oklahoma		F-$280,441 M--$186,961 T-$467,402	

		Funding	WQMPs
Total for Region 6		F-$4,863,297 M-$2,536,067 T-$7,399,364	Dev – 70 Cert – 33 Min - 220

* Defining Abbreviations:
SWCD – Soil & Water Conservation District.
WQMPs - Water Quality Management Plans. These plans are written an/or certified by personnel of the TSSWCB and accepted by the local SWCD. These plans include a comprehensive plan to remediate all potential sources of pollution an individual farm may have.
Dev – The number of WQMPs that have been developed as a part of the project
Cert- The number of WQMPs that have been certified by a TSSWCB staff engineer
Min – The minimum number of WQMPs that are to be developed in the approved grant workplan submitted from the State to EPA.
F – Federal funding amount
M – Match funding (State and in-kind sources) committed
T – Total project amount combining federal and match figures

Appendix C

Possible Monitoring Projects for
Investigation of Atrazine in Region 6

1. Sampling of of Atrazine Raw and Finished Drinking Water for Selected Municipal Drinking Water Supplies in North Central Texas - This possible study would involve the cooperation of one or a limited number of cities located in a high risk watershed. Raw and finished drinking water could be collected on a frequent basis (e.g., daily, 5 days/week) for one year to assess temporal patterns in concentrations of atrazine, and risk to human health and the environment. The study would be coordinated by Region 6 staff. Sampling would be conducted by one or more cities interested in participating at no cost. Analyses would be conducted by the EPA Houston Lab using immunoassay methods. Additional methods (e.g., gas chromatography) could be carried out to supplement and/or confirm immunoassay results. The intent of the study would be to answer the question: "How does atrazine concentration change in raw and finished drinking water over time, and is existing monitoring adequate to characterize seasonal atrazine concentrations?"

   Estimated cost: The only costs incurred would be existing Regional Office and Lab staff time, and inkind cooperation from one or more cities.

2. Sampling of Atrazine in Drinking Water Supply Reservoirs in High Risk Watershed(s) - This possible study would involve collection of ambient water near selected water supply reservoirs located in "high risk" watersheds. The study would be coordinated by Region 6 staff. Sampling would be conducted approximately monthly for one year in the vicinity of the water supply intake structure. Sampling would be carried out by one or two states, or the USGS. This study could include a broad spectrum of modern pesticides using gas chromatography or other methodology. Analyses could potentially be conducted by the EPA Regional Lab, or the USGS Laboratory. The intent of the study would be to answer the question: "Is atrazine present at deleterious concentrations in previously unsampled reservoirs in agricultural and/or urban "high risk" watersheds?

   Estimated cost: Level of effort could be adjusted to budget. Proposed budget:$75K for sample collection and analysis by states or USGS.